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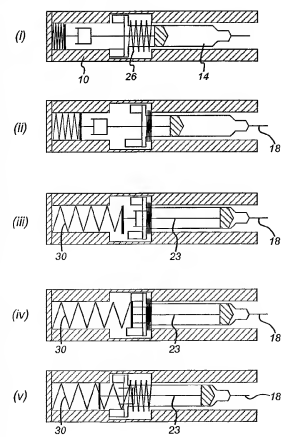
(54) Title: INJECTION DEVICE



(57) Abstract: An injection device (210, 110) is described. A housing (212; 112) receives a syringe and includes a return spring (226; 126) for biasing the syringe from an extended position in which its needle (218; 118) extends from the housing to a retracted position in which the it does not. A drive spring (230; 130) acts on a first drive element (232; 132) and a second drive element (234; 134) acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the needle. The first drive element is capable of movement relative to the second once a nominal decoupling position has been reached. A release mechanism is activated when the first drive element is further advanced to a nominal release position, to release the syringe (214; 114) from the action of the drive spring, whereupon the return spring restores the syringe to its retracted position. The nominal decoupling and release positions are defined relative to the syringe. This may be achieved by interaction between a moving component and a decoupling component (162, 262) that moves with the syringe as it is advanced.

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Injection Device

Background Technology

The present invention relates to an injection device of the type that receives a syringe, extends it, discharges its contents and then retracts it automatically. Devices of this general description are shown in WO 95/35126 and EP-A-0 516 473 and tend to employ a drive spring and some form of release mechanism that releases the syringe from the influence of the drive spring once its contents are supposed to have been discharged, to allow it to be retracted by a return spring.

Because of the stack-up of tolerances of the various components of the device, a certain margin of safety must be built into the activation of the release mechanism, to ensure that it is effective. The consequence of underestimating the safety margin is that the release mechanism may fail to operate even once the syringe contents have been discharged, which is unsatisfactory in a device that is supposed to retract automatically, particularly for self-administered drugs. On the other hand, overestimating the safety margin may mean that some of the syringe contents are discharged after the syringe has retracted, which results firstly in a short dose and secondly in what may be termed a "wet" injection. Wet injections are undesirable for the squeamish, particularly in connection with self-administered drugs.

UK patent applications nos. 0210123, 0229384 and 0325596 describe a series of injection devices designed to deal with this problem. Each makes use of a neat trick that delays the release of the syringe for a certain period of time after the release mechanism has been activated, in an attempt to ensure that the syringe has been completely discharged. The devices illustrated in UK patent application no. 0325596 make use of a two-part drive incorporating a fluid-damped delay mechanism that is particularly effective in ensuring complete discharge of the syringe contents. In each case, the device relies upon two unlatching mechanisms. The first unlatching mechanism initiates the fluid damping mechanism and the second releases the syringe from the actuator, allowing it to be withdrawn. The unlatching mechanisms are activated by components of the injection device having been advanced to nominal unlatching positions relative to the device casework.

A device 10 of this general character is illustrated schematically in figure 1. The sequence of operation is as follows. Firstly, the device 10 is armed. The user presses a release button and the syringe 14 is advanced a distance d_1 by a drive spring 30, thereby

compressing the retraction spring 26. This movement inserts the needle 18 into the patient. The plunger 23 is advanced a distance d_2 by the drive spring 30, injecting most of the dose. Once nearly the entire dose has been injected, the first unlatching mechanism is activated, an operation illustrated schematically by the coincidence of components 1 and 3. The plunger 23 is then advanced a further distance d_3 by the drive spring 30, injecting the rest of the dose. Finally, the second unlatching mechanism is activated, an operation illustrated schematically by the coincidence of components 2 and 4, and the retraction spring 26 then causes the needle 18 to be retracted by the distance d_1.

Since the drive spring acts upon the same component of the device throughout, here referred to as the "actuator", the distance that component must move between the device being armed and the second unlatching mechanism being activated is, subject to tolerance stack-up, equal to the sum of d_1, d_2 and d_3. In the devices described in the applications mentioned above, all of this movement takes place to the rear of the syringe, which means that the overall length of the device must be greater than the sum of the length of the actuator, the distances d_1, d_2 and d_3 and the length of the syringe body not including the needle.

The best design of injection device is one that is compact. This is important both to the ergonomics of the device and to its manufactured cost. The length of the device can be reduced by allowing the actuator to move past the syringe, and by having the unlatching mechanisms activated in front of the syringe. However, this would require the actuator and its unlatching mechanisms to pass around the space occupied by the syringe, involving an increase in diameter of the device that negates the length savings.

Summary of the Invention

It is an objective of the present invention to provide a more compact device. Instead of triggering release of the unlatching mechanisms using a fixed point on the device casework, the present invention does it using one of more features that move forward with the syringe as it is advanced. In other words, the nominal positions at which the unlatching mechanisms are activated are defined relative to the syringe, not relative to the device casework. As illustrated in figure 2, these nominal positions also move

forwards a distance d_1 as the syringe is initially advanced. This in turn means that the initial distance between the actuator and the syringe plunger can be reduced by the distance d_1. The length of the device can be reduced by d_1 at a stroke. More modest improvements are available when only one of the nominal positions at which the unlatching mechanisms are activated is defined relative to the syringe.

Accordingly, a first aspect of the present invention provides an injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle;

first and second drive elements, of which the first is acted upon and the second acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle, the first drive element being capable of movement relative to the second when the former is acted upon and the latter is restrained by the syringe;

a coupling that prevents the first drive element from moving relative to the second until they have been advanced to a nominal decoupling position relative to the syringe.

In this case, the nominal decoupling position, i.e. the first nominal unlatching position, is defined relative to the syringe and not relative to the housing.

Preferably, the device includes:

an actuator that acts upon the first drive element;

means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing; and

a release mechanism, activated when the first drive element has been advanced to a nominal release position that is more advanced than the said nominal decoupling position, and adapted to release the syringe from the action of the actuator, whereupon the biasing means restores the syringe to its retracted position.

In preferred embodiments of the invention, the nominal decoupling position is defined either by one of the drive elements interacting with a decoupling component that moves with the syringe as it is advanced.

For ease of manufacture and assembly, the coupling may comprise flexible arms on one of the drive elements that engage with a drive surface on the other, in which case the decoupling component causes the flexible arms to move when the said nominal decoupling position is reached, thus disengaging them from the drive surface to allow the first drive element to move relative to the second.

A second aspect of the present invention provides an injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle, the housing including means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

first and second drive elements, of which the first is acted upon and the second acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle, the first drive element being capable of movement relative to the second when the former is acted upon and the latter is restrained by the syringe;

a coupling that prevents the first drive element from moving relative to the second until they have been advanced to a nominal decoupling position; and

a release mechanism, activated when the first drive element has been advanced to a nominal release position relative to the syringe that is more advanced than the said nominal decoupling position, and adapted to release the syringe, whereupon the biasing means restores the syringe to its retracted position.

Here, the nominal release position, i.e. the second nominal unlatching position, is defined relative to the syringe and not relative to the housing.

Again, in preferred embodiments, the nominal release position is defined by an actuator or the first drive element interacting with a decoupling component that moves with the syringe as it is advanced. It may be defined by the actuator interacting with

the first drive element once the nominal decoupling position has been reached, at which position the first drive element is restrained by the syringe against further movement.

Once again, for ease of manufacture and assembly, of the actuator and the first drive element, one preferably comprises second flexible arms that engage with a second drive surface on the other, and the release mechanism preferably comprises the said decoupling component, which causes the second flexible arms to move when the said nominal release position is reached, thus disengaging them from the drive surface.

Alternatively, of an actuator and the first drive element, one preferably comprises second flexible arms that engage with a second drive surface on the other, allowing the actuator to act upon the first drive element and preventing the former from moving relative to the latter until the nominal release position has been reached, the second flexible arms are preferably biased toward a position at which they engage the second drive surface and the release mechanism preferably causes them to move against their bias, thus disengaging them from the drive surface.

Brief Description of the Drawings

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figures 1 and 2 are schematic illustrations to which reference has already been made;

Figure 3 is an illustration of a first embodiment of the invention; and

Figure 4 is likewise a second.

Detailed Description

Figure 3 shows an injection device 110 in which a housing 112 contains a hypodermic syringe 114. The syringe 114 is of conventional type, including a syringe body 116 terminating at one end in a hypodermic needle 118 and at the other in a flange 120. The conventional plunger that would normally be used to discharge the contents of the syringe 114 manually has been removed and replaced with a drive element 134 as will be described below, to which is attached a bung 122. The bung 122 constrains a

drug 124 to be administered within the syringe body 116. Whilst the syringe illustrated is of hypodermic type, this need not necessarily be so. Transcutaneous or ballistic dermal and subcutaneous syringes may also be used with the injection device of the present invention. Generally, the syringe must include a discharge nozzle, which in a hypodermic syringe is the needle 118.

As illustrated, the housing includes a return spring 126 that biases the syringe 114 from an extended position in which the needle 118 extends from an aperture 128 in the housing 112 to a retracted position in which the discharge nozzle 118 is contained within the housing 112. The return spring 126 acts on the syringe 114 via a sleeve 127.

At the other end of the housing is a compression drive spring 130. Drive from the drive spring 130 is transmitted via a multi-component drive to the syringe 114 to advance it from its retracted position to its extended position and discharge its contents through the needle 118. The drive accomplishes this task by acting directly on the drug 124 and the syringe 114. Hydrostatic forces acting through the drug 124 and, to a lesser extent, static friction between the bung 122 and the syringe body 116 initially ensure that they advance together, until the return spring 126 bottoms out or the syringe body 116 meets some other obstruction that retards its motion.

The multi-component drive between the drive spring 130 and the syringe 114 consists of three principal components. A drive sleeve 131 takes drive from the drive spring 130 and transmits it to flexible latch arms 133 on a first drive element 132. This in turn transmits drive via flexible latch arms 135 to a second drive element, the drive element 134 already mentioned.

The first drive element 132 includes a hollow stem 140, the inner cavity of which forms a collection chamber 142 in communication with a vent 144 that extends from the collection chamber through the end of the stem 140. The second drive element 134 includes a blind bore 146 that is open at one end to receive the stem 140 and closed at the other. As can be seen, the bore 146 and the stem 140 define a fluid reservoir 148, within which a damping fluid is contained.

A trigger (not shown) is provided on one side of the housing 112. The trigger, when operated, serves to decouple the drive sleeve 131 from the housing 112, allowing it to move relative to the housing 112 under the influence of the drive spring 130. The operation of the device is then as follows.

Initially, the drive spring 130 moves the drive sleeve 131, the drive sleeve 131 moves the first drive element 132 and the first drive element 132 moves the second drive element 134, in each case by acting through the flexible latch arms 133, 135. The second drive element 134 and the bung 122 move and, by virtue of static friction and hydrostatic forces acting through the drug 124 to be administered, move the syringe body 116 against the action of the return spring 126. The return spring 126 compresses and the hypodermic needle 118 emerges from the exit aperture 128 of the housing 112. This continues until the return spring 126 bottoms out or the syringe body 116 meets some other obstruction that retards its motion. Because the static friction between the bung 122 and the syringe body 116 and the hydrostatic forces acting through the drug 124 to be administered are not sufficient to resist the full drive force developed by the drive spring 130, at this point the second drive element 134 begins to move within the syringe body 116 and the drug 124 begins to be discharged. Dynamic friction between the bung 122 and the syringe body 116 and hydrostatic forces acting through the drug 124 to be administered are, however, sufficient to retain the return spring 126 in its compressed state, so the hypodermic needle 118 remains extended.

Before the second drive element 134 reaches the end of its travel within the syringe body 116, so before the contents of the syringe have fully discharged, the flexible latch arms 135 linking the first and second drive elements 132, 134 reach a constriction 137. The constriction 137 is formed by a component 162 that is attached to the syringe flange 120, so it will be understood that when the syringe 114 advances from its retracted position to its extended position, the component 162 advances with it. The constriction 137 moves the flexible latch arms 135 inwards from the position shown to a position at which they no longer couple the first drive element 136 to the second drive element 134, aided by the bevelled surfaces on the constriction 137.

Once this happens, the first drive element 136 acts no longer on the second drive element 134, allowing the first drive element 132 to move relative to the second drive element 134.

Because the damping fluid is contained within a reservoir 148 defined between the end of the first drive element 132 and the blind bore 146 in the second drive element 134, the volume of the reservoir 148 will tend to decrease as the first drive element 132 moves relative to the second drive element 134 when the former is acted upon by the drive spring 130. As the reservoir 148 collapses, damping fluid is forced through the vent 144 into the collection chamber 142. Thus, once the flexible latch arms 135 have been released, the force exerted by the drive spring 130 does work on the damping fluid, causing it to flow through the constriction formed by the vent 144, and also acts hydrostatically through the fluid, to drive the second drive element 134. Losses associated with the flow of the damping fluid do not attenuate the force acting on the body of the syringe to a great extent. Thus, the return spring 126 remains compressed and the hypodermic needle 118 remains extended.

After a time, the second drive element 134 completes its travel within the syringe body 116 and can go no further. At this point, the contents of the syringe 114 are completely discharged and the force exerted by the drive spring 130 acts to retain the second drive element 134 in its terminal position and to continue to cause the damping fluid to flow through the vent 144, allowing the first drive element 132 to continue its movement.

Before the reservoir 148 of fluid is exhausted, the flexible latch arms 133 linking the drive sleeve 131 with the first drive element 132 reach another constriction 139, also provided by the component 162 that is attached to the syringe flange 120. The constriction 139 moves the flexible latch arms 133 inwards from the position shown to a position at which they no longer couple the drive sleeve 131 to the first drive element 132, aided by the bevelled surfaces on the constriction 139. Once this happens, the drive sleeve 131 acts no longer on the first drive element 132, allowing them to move relative to each other. At this point, of course, the syringe 114 is released, because the force developed by the drive spring 130 is no longer being

transmitted to the syringe 114, and the only force acting on the syringe will be the return force from the return spring 126. Thus, the syringe 114 now returns to its retracted position and the injection cycle is complete.

All this takes place, of course, only once the cap 111 has been removed from the end of the housing 112. As can be seen from figure 3, the end of the syringe is sealed with a boot 123. The central boss 121 of the cap 111 is hollow at the end and a lip 125 of the hollow end is bevelled on its leading edge 157, but not its trailing edge. Thus, as the cap 111 is installed, the leading edge 157 of the lip 125 rides over a shoulder 159 on the boot 123. However, as the cap 111 is removed, the trailing edge of the lip 125 will not ride over the shoulder 159, which means that the boot 123 is pulled off the syringe 114 as the cap 111 is removed.

Figure 4 shows another injection device 210 in which a housing 212 contains a hypodermic syringe 214. The syringe 214 is again of conventional type, including a syringe body 216 terminating at one end in a hypodermic needle 218 and at the other in a flange 220, and a rubber bung 222 that constraints a drug 224 to be administered within the syringe body 216. The conventional plunger that would normally be connected to the bung 222 and used to discharge the contents of the syringe 214 manually, has been removed and replaced with a multi-component drive element as will be described below. Whilst the syringe illustrated is again of hypodermic type, this need not necessarily be so. As illustrated, the housing includes a return spring 226 that biases the syringe 214 from an extended position in which the needle 218 extends from aperture 228 in the housing 212, to a retracted position in which the hypodermic needle 218 is contained within the housing 212. The return spring 226 acts on the syringe 214 via a sleeve 227.

At the other end of the housing is a compression drive spring 230. Drive from the drive spring 230 this transmitted via the multi-component drive to the syringe 214 to advance it from its retracted position to its extended position and discharge its contents through the needle 218. The drive accomplishes this task by acting directly on the drug 224 and the syringe 214. Static friction between the bung 222 and the syringe body 216 initially ensures that they advance together, until the return spring

226 bottoms out or the syringe body 216 meets some other obstruction that retards its motion.

The multi component drive between the drive spring 230 and the syringe 214 again consists of three principal components. The drive sleeve 231 takes drive from the drive spring 230 and transmits it to flexible latch arms 233 on a first drive element 232. These elements are shown in detail "A". The first drive element 232 in turn transmits drive via flexible latch arms 235 to a second drive element 234. These elements are shown in detail "B". As before, the first drive element 232 includes a hollow stem 240, the inner cavity of which forms a collection chamber 242. The second drive element 234 includes a blind for 246 that is open at one end to receive the stem 240 and closed at the other. As can be seen, the bore 246 and the stem 240 define a fluid reservoir 248, within which a damping fluid is contained.

A trigger (not shown) is provided in the middle of the housing 212. The trigger, one operated, serves to decouple the drive sleeve 231 from the housing 212 allowing it to move relative to the housing 212 under the influence of the drive spring 230. The operation of the device is then as follows.

Initially, the drive spring 230 moves the drive sleeve 231, the drive sleeve 231 moves the first drive element 232 and the first drive element 232 moves the second drive element 234, in each case by acting through the flexible matching arms 233, 235. The second drive element 234 moves and, by virtue of static friction and hydrostatic forces acting through the drug 224 to be administered, moves the syringe body 216 against the action of the return spring 226. The return spring 226 compresses and the hypodermic needle 218 emerges from the exit aperture 228 of the housing 212. This continues until the return spring 226 bottoms out or the syringe body 216 meets some other obstruction that retards its motion. Because the static friction between the bung 222 and the syringe body 216 and the hydrostatic forces acting through the drug 224 to be administered are not sufficient to resist the full drive force developed by the drive spring 230, at this point the second drive element 234 begins to move within the syringe body 216 and the drug 224 begins to be discharged. Dynamic friction between the bung 222 and the syringe body 216 and hydrostatic forces acting through the drug

224 to be administered are, however, sufficient to retain the return spring 226 in its compressed state, so the hypodermic needle 218 remains extended.

Before the second drive element 234 reaches the end of its travel within the syringe body 216, so before the contents of the syringe have fully discharged, the flexible latch arms 235 linking the first and second drive elements 232, 234 reach a constriction 237. The constriction 237 is formed by a component 262 that is attached to the syringe carrier. Additional flexible arms 247 overlie the flexible arms 235 on the first drive element 232, by means of which drive is transmitted to the second drive element 234. Figure 4 illustrates the injection device 210 at the position where the additional flexible arms 247 are just making contact with the constriction 237 in the component 262.

The constriction 237 moves the additional flexible arms 247 inwards, aided by the bevelled surfaces on both, and the additional flexible arms 247 in turn move the flexible arms 235, by means of which drive is transmitted from the first drive element 232 to the second drive element 234, inwards from the position shown to a position at which they no longer couple the first and second drive elements together. Once this happens, the first drive element 232 acts no longer on the second drive element 234, allowing the first drive element 232 to move relative to the second drive element 234.

Because the damping fluid is contained within a reservoir 248 defined between the end of the first drive element 232 and the blind bore 246 in the second drive element 234, the volume of the reservoir 248 will tend to decrease as the first drive element 232 moves relative to the second drive element 234 when the former is acted upon by the drive spring 230. As the reservoir 248 collapses, damping fluid is forced into the collection chamber 242. Thus, once the flexible latch arms 235 have been released, the force exerted by the drive spring 230 does work on the damping fluid, causing it to flow into the collection chamber 242, and also acts hydrostatically through the fluid, thence via the second drive element 234. Losses associated with the flow of the damping fluid do not attenuate the force acting on the body of the syringe to a great extent. Thus, the return spring 226 remains compressed and the hypodermic needle remains extended.

After a time, the second drive element 234 completes its travel within the syringe body 216 and can go no further. At this point, the contents of the syringe 214 are completely discharged and the force exerted by the drive spring 230 acts to retain the second drive element 234 in its terminal position and to continue to cause the damping fluid to flow into the collection chamber 142, allowing the first drive element 232 to continue its movement.

A flange 270 on the rear of the second drive element 234 normally retains the flexible arms 233 in engagement with the drive sleeve 231. However, before the reservoir 248 of fluid is exhausted, the flexible latch arms 233 linking the drive sleeve 231 with the first drive element 232 move sufficiently far forward relative to the second drive element 234 that the flange 270 is brought to register with a rebate 272 in the flexible arms 233, whereupon it ceases to be effective in retaining the flexible arms 233 in engagement with the drive sleeve 231. Now, the drive sleeve 231 moves the flexible latch arms 233 inwards from the position shown to a position at which they no longer couple the drive sleeve 231 to the first drive element 232, aided by the bevelled latching surfaces 274 on the flexible arms 233. Once this happens, the drive sleeve 231 acts no longer on the first drive element 232, allowing them to move relative to each other. At this point, of course, the syringe 214 is released, because the forces developed by the drive spring 230 are no longer being transmitted to the syringe 214, and the only force acting on the syringe will be the return force from the return spring 226. Thus, the syringe 214 now returns to its retracted position and the injection cycle is complete.

Claims

1. An injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle;

first and second drive elements, of which the first is acted upon and the second acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle, the first drive element being capable of movement relative to the second when the former is acted upon and the latter is restrained by the syringe; and

a coupling that prevents the first drive element from moving relative to the second until they have been advanced to a nominal decoupling position relative to the syringe.

2. An injection device according to claim 1 including:

an actuator that acts upon the first drive element;

means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing; and

a release mechanism, activated when the first drive element has been advanced to a nominal release position that is more advanced than the said nominal decoupling position, and adapted to release the syringe from the action of the actuator, whereupon the biasing means restores the syringe to its retracted position.

3. An injection device according to claim 1 or claim 2 in which the nominal decoupling position is defined by one of the drive elements interacting with a decoupling component that moves with the syringe as it is advanced.

4. An injection device according to any one of claims 1-3 in which:

the coupling comprises cooperating features of the first and second drive elements that allow the first to act upon the second.

5. An injection device according to claim 4 in which the cooperating features include flexible arms on one of the drive elements that engage with a drive surface on the other.

6. An injection device according to any preceding claim in which the coupling comprises a decoupling mechanism, activated when the drive elements have been advanced to the said nominal decoupling position and adapted to decouple the first drive element from the second, thus allowing the first drive element to move relative to the second.

7. An injection device according to claim 3, in which:

the coupling comprises flexible arms on one of the drive elements that engage with a drive surface on the other; and

the decoupling component causes the flexible arms to move when the said nominal decoupling position is reached, thus disengaging them from the drive surface to allow the first drive element to move relative to the second.

8. An injection device according to claim 4, in which:

the coupling comprises flexible arms on one of the drive elements that engage with a drive surface on the other; and

the decoupling component causes the flexible arms to move when the said nominal decoupling position is reached, by acting on an intermediate component, thus disengaging the flexible arms from the drive surface to allow the first drive element to move relative to the second.

9. An injection device according to claim 8 in which the intermediate component is a flexible component of the drive element upon which the said drive surface is to be found.

10. An injection device according to any one of claims 5, 7 and 8 in which the flexible arms are biased toward a position at which they engage the drive surface and the decoupling component causes them to move against their bias, thus disengaging them from the drive surface.

11. An injection device comprising:

a housing adapted to receive a syringe having a discharge nozzle, the housing including means for biasing the syringe from an extended position in which the discharge nozzle extends from the housing to a retracted position in which the discharge nozzle is contained within the housing;

first and second drive elements, of which the first is acted upon and the second acts upon the syringe to advance it from its retracted position to its extended position and discharge its contents through the discharge nozzle, the first drive element being capable of movement relative to the second when the former is acted upon and the latter is restrained by the syringe;

a coupling that prevents the first drive element from moving relative to the second until they have been advanced to a nominal decoupling position; and

a release mechanism, activated when the first drive element has been advanced to a nominal release position relative to the syringe that is more advanced than the said nominal decoupling position, and adapted to release the syringe, whereupon the biasing means restores the syringe to its retracted position.

12. An injection device according to any one of claims 1-11, in which the release mechanism is activated when the first drive element has been advanced to a nominal release position relative to the syringe.

13. An injection device according to claim 11 or claim 12 in which the nominal release position is defined by the first drive element, or an actuator that acts upon it, interacting with a decoupling component that moves with the syringe as it is advanced.

14. An injection device according to claim 11 or claim 12 in which the nominal release position is defined by an actuator interacting with the first drive element once the nominal decoupling position has been reached.

15. An injection device according to any one of claims 11-14 in which the release mechanism is adapted to decouple the first drive element from an actuator once the

said nominal release position has been reached, thus releasing the syringe from the action of the actuator.

16. An injection device according any one of claims 11-15, further comprising a second coupling, between an actuator and the first drive element, that prevents the actuator from moving relative to the first drive element until the nominal release position has been reached.

17. An injection device according to claim 16 in which the second coupling comprises cooperating features of the actuator and the first drive element allowing the former to act upon the latter.

18. An injection device according to claim 17 in which:

the cooperating features of the actuator and the first drive element include second flexible arms on one of them engaged with a second drive surface on the other; and

the release mechanism comprises a decoupling component that causes the second flexible arms to move when the said nominal release position is reached, thus disengaging them from the drive surface to allow the actuator to move relative to the first drive element.

19. An injection device according to claims 2 or claim 13, in which:

of the actuator and the first drive element, one comprises second flexible arms that engage with a second drive surface on the other, allowing the actuator to act upon the first drive element and preventing the former from moving relative to the latter until the nominal release position has been reached;

the release mechanism comprises the said decoupling component, which causes the second flexible arms to move when the said nominal release position is reached, thus disengaging them from the drive surface to allow the actuator to move relative to the first drive element.

20. An injection device according to claim 14, in which:

of the actuator and the first drive element, one comprises second flexible arms that engage with a second drive surface on the other, allowing the actuator to act upon the first drive element and preventing the former from moving relative to the latter until the nominal release position has been reached; and

the second flexible arms are biased toward a position at which they engage the second drive surface and the release mechanism causes them to move against their bias, thus disengaging them from the drive surface.

FIG. 1

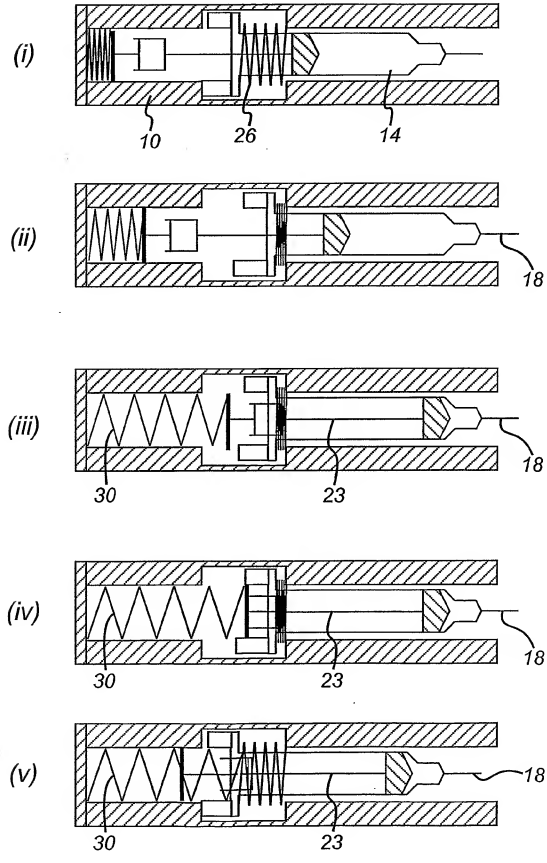


FIG. 2

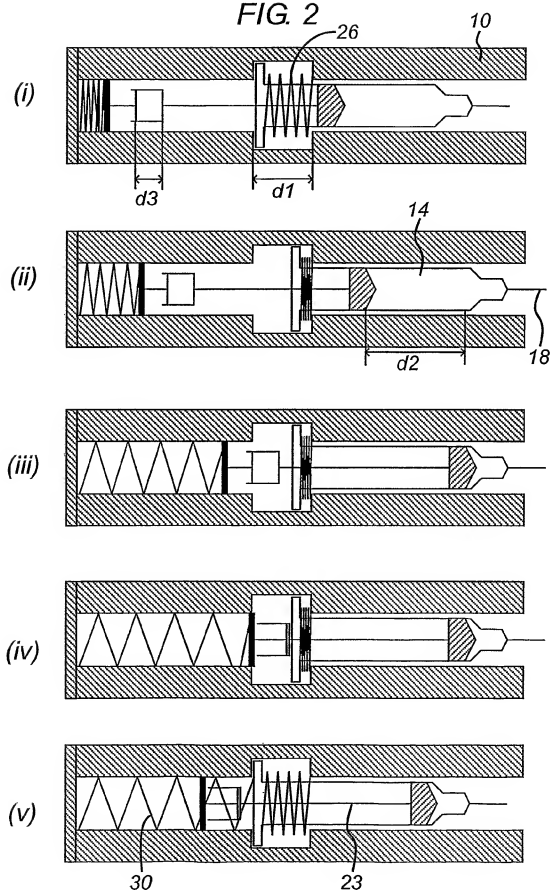
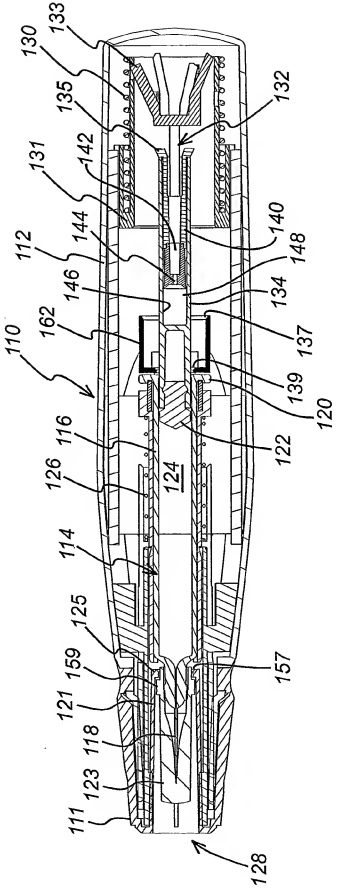


FIG. 3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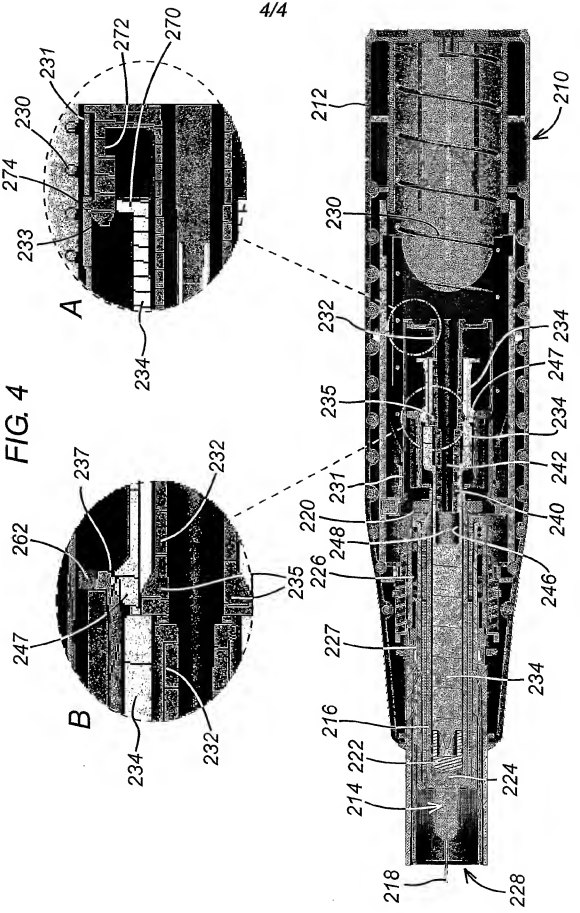
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FIG. 4

INTERNATIONAL SEARCH REPORT

Inter ... al Application No
PCT/GB2005/002131

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61M5/20 A61M5/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/092771 A (PA KNOWLEDGE LIMITED; MARTIN, JEFFREY; HUGHES, MARTIN, LAWRENCE) 13 November 2003 (2003-11-13) abstract; figure 5a	1-20
X	US 2001/005781 A1 (BERGENS THOMAS ET AL) 28 June 2001 (2001-06-28) abstract; figures 3A-3J	1,11
P,X	WO 2004/054645 A (CILAG AG INTERNATIONAL; HARRISON, NIGEL, DAVID; BRADY, MATTHEW, JAMES;) 1 July 2004 (2004-07-01) abstract; figures	1,11
X	WO 03/097133 A (OWEN MUMFORD LIMITED; MARSHALL, JEREMY) 27 November 2003 (2003-11-27) abstract; figures 3-5	1-20

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 August 2005	05/09/2005

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB2005/002131

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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